Children and Adults Consider Others' Resources When Inferring Their Emotions

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Abstract

The amount of resources someone has can influence their emotional responses to events. Two preregistered experiments investigated whether adults and children consider others' resource quantities when inferring their emotions. Sixty adults (Experiment 1) and 135 8-10-year-olds (Experiment 2) saw stories about people wanting an item but differing in the number of items they have enough money to buy (ranging from 1 to 5). Participants rated how these people felt both when buying the item and when losing it. Both adults and children judged that the fewer resources someone has, the sadder they felt when the item was lost, and the bigger emotional change they experienced (relative to when buying the item). Adults also judged that the impact of resource scarcity on emotion was most significant when the person had depleted all their resources, as opposed to still retaining some to influence the negative outcome, and this pattern is emerging in children. These findings suggest that even when the same negative event occurs, adults and children as young as 8 consider others' available resources when inferring their emotional responses to the event.

Keywords: emotion understanding; resource valuation; social cognition; intuitive theories; appraisal theories

Introduction

Suppose you see someone spend their last dollar on a donut, only to lose it before they can take the first bite. You might expect the person to be very sad, as they have encountered a negative event for which there is no remedy. Now, let's re-imagine the situation: this time, the person initially had enough money to buy many donuts. How might their emotional response differ in this case? While you might anticipate that the person would still feel some sadness from losing the donut, you might also infer that their sadness would be mitigated by their ability to buy more. In these cases, people do not infer others' emotions merely based on the outcome they face. They also consider whether the person has enough resources to deal with the outcome. In this paper, we examine whether adults and children are able to incorporate the resources others have when inferring their emotions.

The ability to accurately infer others' emotions is crucial for successful social interactions. This ability has been extensively studied, finding that not only adults but also young children can infer others' emotions by appraising external eliciting events and others' internal mental states (e.g., Barden, Zelko, Duncan, & Masters, 1980; Widen & Russell, 2010, 2011; also see Molinari et al., 2009; Mouw, Leijenhorst, Saab, Danel, & van den Broek, 2019 for work with adults, and Doan, Ong, & Wu, 2023 for a review). For example, young children infer that someone would feel happy about a positive event, like receiving presents, and feel sad about a negative event, like their fish dying (Widen & Russell, 2011). With age, children also learn to infer that someone would feel happy when their desires are fulfilled and sad when they are not (e.g., Hadwin & Perner, 1991; Wellman & Banerjee, 1991; Wellman & Woolley, 1990). However, as the opening example illustrates, even when people are confronted with the same event and desire, a critical factor varying among them is the extent of their available resources. Particularly in the case of negative events, one's available resources play a substantial role in determining their ability to deal with the event, consequently shaping how they would feel about the event.

Prior work examining the connection between resources and emotions has primarily focused on first-person emotional experiences. On a theoretical level, one family of classic theories—appraisal theories—proposes that adults' first-person emotional experiences are elicited by their evaluation of their situation along motivationally-relevant appraisal dimensions. A wide range of appraisal dimensions have been proposed, including the appraisal of whether the situation is consistent with one's goals, familiar to them, or fair to them. While resource is not a specified dimension, they are included in one of the core appraisal dimensions called *power*. The power dimension refers to the appraisal of one's ability to influence or modify the outcome of a situation (also known as problem-focused coping potential; e.g., Lazarus, 1991; Scherer, 1993). As defined by this literature, one's power encompasses their strength, knowledge, social attractiveness, ability to recruit others for help, and notably, their financial resources, such as money (see Ellsworth & Scherer, 2003).

Grounded in appraisal theories, empirical work has examined people's perceived power to influence a situation in relation to their emotional experiences. Supporting evidence has primarily relied on people's recall of past events. For example, adults have been asked to recall a situation that made them feel a specific emotion and to rate the situation along various appraisal dimensions, including whether the situation was something they thought they had power to influence (e.g., Roseman, Antoniou, & Jose, 1996; Smith & Ellsworth, 1985). It has been found that negative situations that elicit emotions like frustration and anger are ones people judged they had the power to deal with, but situations that elicit emotions like sadness, disappointment, sorrow, hurt, and shame are ones they felt they did not (e.g., Frijda, Kuipers, & ter Schure, 1989; Hardecker, 2020; Lemay, Overall, & Clark, 2012; Roseman et al., 1996; Smith & Ellsworth, 1985).

Comparably less work has examined this topic in children, but available research has used the same event-recall paradigm and showed converging results. For example, Sillars and Davis (2018) asked children to recall a situation that made them feel very sad, very scared, or very angry. For each situation, children had to judge whether it was something they felt they could have handled or not. By age 4, children appraised negative situations that made them angry as events they felt they could have handled, but appraised situations that made them sad as ones they felt they could not. Together, both theoretical and empirical work on first-

In L. K. Samuelson, S. L. Frank, M. Toneva, A. Mackey, & E. Hazeltine (Eds.), *Proceedings of the 46th Annual Conference of the Cognitive Science Society.*

person emotional experiences suggests that adults' and children's emotional responses to negative outcomes are associated with their perceived power to influence those outcomes.

While these past studies suggest an association between one's power and the emotion they might feel, the studies do not give insight as to whether people possess an abstract, intuitive theory of how these two variables relate. That is, people in those studies, particularly young children, could have simply recalled events that elicited certain emotions when asked, and then rated their ability to influence those events, without realizing the causal connection between the two. In such cases, specific emotional experiences may simply be encoded in memory as scripts, rather than developing into abstract, intuitive theories of emotion capable of supporting flexible, causal inferences that extend to a broader range of situations, including those involving third-person emotion reasoning.

Further, these past studies have focused on the categorical mappings between power and emotion. For example, high power appraisal is often associated with anger while low power appraisal is often associated with sadness. However, as power is a continuous variable, it remains unclear how quantitative changes in power appraisal lead to quantitative changes in emotion. One study started to investigate this relation. In the study, children saw scenarios where one person had 2 yo-yos and another person had 5 yo-yos. When they each received one more yo-yo, children were asked to identify who would feel "super happy" and who would feel "sort of happy." By ages 7 and 8, children correctly predicted that the one with 2 yo-yos would feel super happy while the person with 5 yo-yos would feel sort of happy. Similarly, when each person lost one yo-yo, children predicted that the one with 2 yo-yos would feel super sad while the person with 5 yo-yos would feel sort of sad (Ahl, Cook, & Auliffe, 2023). This provides initial support that children understand how resource quantity influences others' emotions. That said, children still could have succeeded by doing categorical mappings (e.g., linking the one with 2 yo-yos to super happy and the one with 5 yo-yos to sort of happy) as the study used only two resource quantities (2 vs. 5 yo-yos) and two levels of an emotion (e.g., "super" vs. "sort of" happy). It remains unclear whether children can make more graded judgments, like predicting how decremental changes in someone's resource quantity might lead to graded changes in that person's emotions.

The current study investigates adults' and children's understanding of how resource quantity affect others' emotions. This study is distinct from prior work in three key ways. First, instead of prompting people to recall their own emotional experiences, we asked adults and children to reason about the emotion of a third party. This allows us to test if even young children can go beyond their immediate, memorized past experience, and flexibly draw causal inferences about other people, grounded in their abstract, intuitive theory of emotion. Second, rather than using power as a general construct representing someone's potential to influence an outcome, we focused on one specific type of power—financial resources, or money—as a starting point, because it is easy to quantify and manipulate. Last, distinct from the approach taken by Ahl et al. (2023), where two agents with differing amounts of resources were pitted against each other and children were asked to map them to two levels of an emotion (e.g., "super" vs "sort" of happy), we asked children to rate how someone feels based on the person's available resource using a continuous (7-point) emotion scale. This enables us to assess people's quantitative predictions of others' emotions as a function of their resource quantity.

In two preregistered experiments, adults and 8-10-year-olds saw stories where someone wants a food item (e.g., a donut).[1] The person buys one item but then drops it before getting to eat it. The key factor we manipulated across stories was the amount of money the person initially had, ranging from having enough money to buy one to five items. Participants rated the person's emotions both when they buy their item (initial emotion rating) and when they lose it (final emotion rating), using a 7-point emotion scale ranging from extremely sad to extremely happy. We were interested in whether the varying resource quantities would influence participants' emotion judgments.

For initial emotion ratings, we had no a priori predictions about how resource quantity would influence emotion judgments but measured it as a reference point. It is possible that participants might judge someone with less money as happier when buying a desired item, as they may value it more, compared to someone with more money. It is also possible that resource quantity would not influence these inferences because the person gained an item at the expense of their money, resulting in no net change in their overall possession value.

Our key measure was the final emotion rating. Our preregistered prediction was that participants would infer that the fewer resources someone has, the sadder they will be when losing their item. Beyond this general linear relationship, we additionally wanted to know whether participants might be sensitive to the binary distinction between when someone cannot change the negative outcome (i.e., initially can only buy one item, leaving no money to buy more) and when they can change the outcome (initially can buy two or more items, thus having money left to buy more). If participants are sensitive to this distinction, the decremental emotion shifts between conditions would be largest when the shift in initial resources goes from two to one, compared to other decremental resource changes (e.g., from four to three, three to two). If participants are not sensitive to that, the decremental emotion shifts would be consistent in each decremental resource shift. While we did not have strong predictions about which possibility is more likely, we preregistered analyses to differentiate them by looking at the effect size when comparing adjacent resource conditions (e.g., 1vs2, 2vs3, 3vs4).

We predicted similar patterns when looking at the differ-

[1] Preregistrations can be found at `https://aspredicted.org/JTT_T3H` (Experiment 1) and `https://aspredicted.org/KLF_4SH` (Experiment 2).

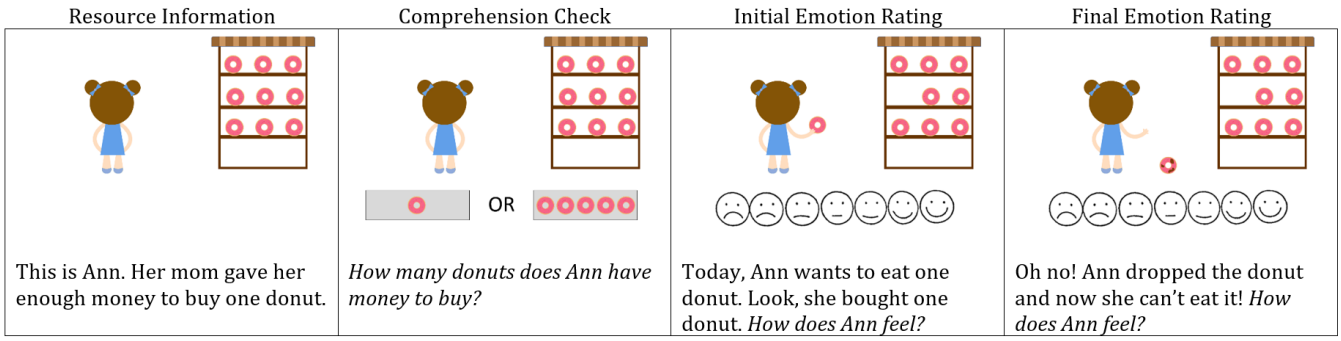

Figure 1: Sample stimuli and script for Experiments 1 and 2.

ence between initial and final emotion ratings. This measure incorporates the reference point when the person buys the item, capturing their change in emotion. We predicted that the fewer resources the person has, the larger their emotional decline when they lose their item. Additionally, we were interested in whether the difference in emotional decline between conditions would be largest when the shift in initial resources goes from two to one, compared to other decremental shifts.

We tested adults in Experiment 1 using a full range of resource conditions (i.e., having money to buy one, two, three, four, and five items). We then tested children in Experiment 2 to explore the development of this ability. We used the conditions of having money to buy one, three, and five items to shorten the experiment while covering the broad spectrum of resource quantity. As Ahl et al. (2023) found a connection between resource quantity and emotion inferences in children ages 7–8, and our study involves more graded emotion judgments, we focused on children ages 8–10.

Experiment 1

Methods

Participants We recruited 60 adults from the United States (mean age=39.47; 27 females, 31 males, 2 non-binary) on *Prolific*, an online recruitment platform. All participants' first language was English. Participants reported their race/ethnicity as White (n=48), Asian or Asian American (n=2), Black or African American (n=3), Hispanic, Latino, Latina, or Latinx (n=3), mixed (n=3), or preferred not to respond (n=1). Participants were compensated $1 USD.

Procedure Participants completed the experiment online through a web-based testing platform called *Qualtrics*. Each participant read 10 stories and rated a protagonist's emotion at two time points in each story. For example, in one story about a protagonist named Ann (see Figure 1), participants first read that her mom gave her enough money to buy one donut. A comprehension question followed to ensure that participants remembered the number of donuts Ann had enough money to buy. If they answered incorrectly, they were reminded of the correct answer and re-asked the comprehension question. All participants answered the question correctly the first time.

Participants then read that Ann wanted to eat a donut today so she bought one. Participants were asked to rate how Ann felt at that point (initial emotion rating), using a 7-point emotion scale that ranges from very sad to very happy. Next, participants read that Ann dropped her donut so she could no longer eat it. Participants were again asked to rate Ann's emotion (final emotion rating), using the same emotion scale.

All stories were similar except for one critical manipulation: the protagonist in each story initially had enough money to buy either one, two, three, four, or five food items. So although all protagonists dropped a newly bought item, they differed in their number of available resources and thus their ability to deal with the negative outcome. Additionally, we either counterbalanced or randomized factors that were not central to our hypothesis, including the type of food item, the protagonist's gender, and the order of trials. Specifically, five stories involved females and donuts, and the other five involved males and juice boxes. These were blocked such that half the participants saw donut trials first and the other half saw juice box trials first (randomly assigned). Each block consisted of randomly presented trials of protagonists having enough money to buy one, two, three, four, or five food items.

Results and Discussion

Raw emotion ratings As preregistered, we analyzed participants' responses with a mixed-effects model using the *lme4* package in *R*. We included condition (number of items the person can buy: 1, 2, 3, 4, 5), rating type (initial, final), and their interaction as fixed effects. We started with a maximal random effect structure where random intercepts and random slopes of condition, rating type and their interaction were fit by subject. Random effects were pruned if the model failed to converge (Barr, Levy, Scheepers, & Tily, 2013). The final full model was: `Rating ~ Condition * Rating type, random = ~ Rating type | Participant, method = "REML"`. We found an effect of condition, $F(4, 1131) = 17.06$, $p < .001$, rating type, $F(1, 1131) = 852.42$, $p < .001$, and a condition by rating type interaction, $F(4, 1131) = 56.26$, $p < .001$.

Also following our preregistered analysis, we examined this interaction by looking at the effect of condition for each

rating type. We preregistered that we would run pairwise comparisons for 1vs2, 2vs3, 3vs4, and 4vs5, for both initial ratings (if there is an effect of condition) and final ratings. We also preregistered that we would correct p-values for multiple comparisons (significant p=0.05/4=0.0125), and use Cohen's d to quantify the effect sizes of these comparisons.

For initial ratings, there was an effect of condition, $F(4,536) = 9.34$, $p < .001$, suggesting an overall pattern that adults judged that the fewer resources someone has, the happier they will be when buying a desired item. Pairwise comparisons with p-values corrected revealed that initial ratings were only different when comparing 2 and 3 resources, $p = .008$, $d = 0.36$, but all other step-wise comparisons (i.e., 1vs2, 3vs4, 4vs5) were not, $ps \geq .041$, $ds \leq 0.27$. See Figure 2A. This suggests that while there is an overall linear relation between resource quantity and emotion, the effect size of each unit of resource change is not large.

For final ratings, there was also an effect of condition, $F(4,536) = 50.65$, $p < .001$, suggesting an overall pattern that adults judged that the fewer resources someone has, the sadder they will be when losing their item. Pairwise comparisons with p-values corrected revealed significant differences in almost all step-wise comparisons: 1vs2, $p < .001$, $d = 0.78$; 2vs3, $p = .070$, $d = 0.24$; 3vs4, $p = .012$, $d = 0.33$; 4vs5, $p = .006$, $d = 0.37$. The effect size when comparing 1 and 2 resources is numerically the largest compared to those of other step-wise comparisons (i.e., 2vs3, 3vs4, 4vs5). See Figure 2A. This is consistent with the idea that adults are sensitive to the binary distinction between when someone has no money left to buy more (initially had only 1 resource) and still has money to influence the negative outcome (initially had 2-5 resources) when inferring their emotions.

Difference between initial and final emotion ratings Next, we examined the difference between participants' initial and final emotion ratings. Difference scores were calculated by subtracting participants' final emotion rating from their initial emotion rating within each story. We started with a maximal random effect structure and pruned as needed. The final model was: `Difference ~ Condition, random = ~ 1 | Participant, method = "REML"`. As above, we preregistered that if there is an effect of condition, we would run pairwise comparisons for 1vs2, 2vs3, 3vs4, and 4vs5.

There was an effect of condition, $F(4,536) = 56.86$, $p < .001$, suggesting that adults judged that the fewer resources someone has, the larger the decline in emotion when the negative event occurs. Pairwise comparisons with p-values corrected revealed significant differences in most comparisons: 1vs2, $p < .001$, $d = 0.96$; 2vs3, $p = .007$, $d = 0.36$; 3vs4, $p = .094$, $d = 0.21$; 4vs5, $p = .003$, $d = 0.41$. Similar to the final ratings, the effect size when comparing 1 and 2 resources is numerically the largest compared to those of other step-wise comparisons. See Figure 2B. Again, this suggests that adults are sensitive to the distinction between when someone has no money left and when they still have money to deal with the outcome when inferring their emotions.

Overall, this first experiment shows that adults consider other people's resources when inferring their emotions. Consistent with our predictions, adults judged that fewer resources led to sadder emotional responses to a negative event. Further, the decremental emotion shift was largest when initial resources drop from 2 to 1, compared to other decremental resource changes. This suggests that adults distinguished between whether someone has depleted their resources (initially had only 1 resource) or still retains some influence over the outcome (initially had 2-5 resources). Consistent patterns also emerged when examining the difference scores, which incorporated initial emotion ratings (a reference point also influenced by resource quantity). Next, we examined whether 8-10-year-olds had the same intuitions.

Experiment 2

Methods

Participants We tested 135 English-speaking 8-10-year-olds ($M_{Age} = 9.47$; range=8.01-10.99; 66 females, 69 males) on *Lookit*, an online platform for developmental research (Scott, Chu, & Schulz, 2017; Scott & Schulz, 2017). We had 45 8-year-olds ($M_{Age} = 8.42$; range=8.01-8.98), 45 9-year-olds ($M_{Age} = 9.51$; range=9.04-9.99), and 45 10-year-olds ($M_{Age} = 10.47$; range=10.00-10.99). Ten additional children were tested but excluded due to parental interference (n=2), and parental report of autism spectrum disorder (n=8). Families' reported race/ethnicity is White (n=77), Asian (n=16), Black or African American (n=7), Hispanic, Latino, or Spanish origin (n=5), American Indian or Alaska Native (n=1), multiple race/ethnicity (n=27), or no response (n=2). Compensation was a $5 USD or $7 CAD Amazon giftcard.

Procedure Children participated remotely with their parent or legal guardian. The experiment closely resembled Experiment 1 but was modified to make it more suitable for children.

First, we added a training session with 3 brief parts at the beginning of the experiment to familiarize children with the response measures used in the main task. Part 1 familiarized children to the 7-point emotion scale. Children were told the meaning of each face on the scale, which represented, from left to right, the following emotions: "very, very sad", "pretty sad", "a little bit sad", "just okay", "a little bit happy", "pretty happy", and "very, very happy." Part 2 had 4 trials where children practiced clicking on the faces. A green box appeared on one face and children were asked to click on that face. The faces chosen for practice represented feeling very very sad, pretty sad, just okay, and a little bit happy (order randomized across children). Parts 1 and 2 prepared children for responding to test questions in the main task. Part 3 had two practice trials involving the selection of boxes. Each trial presented two side-by-side boxes with varying numbers of stars. Children were asked to choose the box with a specific number of stars. This prepared children for responding to comprehension questions in the main task.

Second, we reduced the number of stories children heard to better suit their attention spans. In the previous experiment,

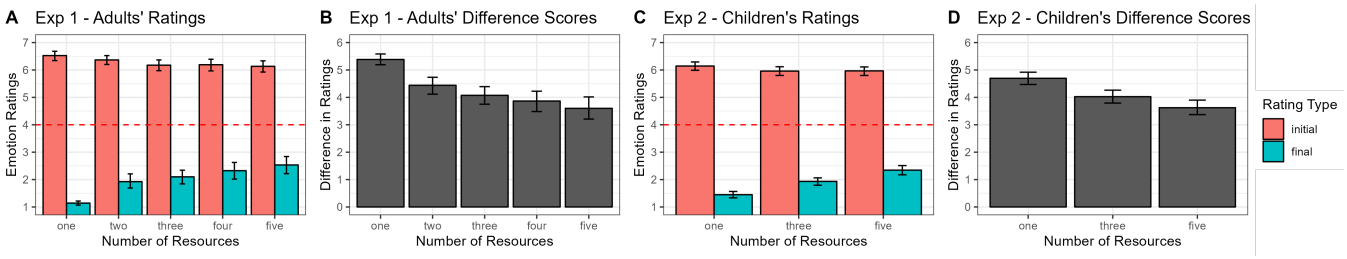

Figure 2: Participants' initial (red) and final (blue) emotion ratings and difference scores (initial minus final)

five different resource conditions were presented, each illustrated through both donut and juice box scenarios, resulting in 10 stories per adult participant. Here, we limited the resource conditions to only those with one, three, and five resources but kept both the donut and juice box scenarios, yielding six stories per child. Removing the intermediate conditions shortened the experiment while still allowing us to cover the same range in the number of resources as in Experiment 1.

Third, instead of presenting the script as written text (with illustrations; see Figure 1), we recorded the script as audio using child-directed speech which played as children progressed through each story. This accommodates children's developing literacy skills and makes the task more engaging.

Results and Discussion

Raw emotion ratings We analyzed children's responses in the same way as Experiment 1, with the addition of age (continuous, centered) included as a fixed effect. The final full model was: `Rating ~ Condition * Rating type * Age, random = ~ Rating type | SubID, method = "REML"`. There was an effect of condition, $F(2,1475) = 24.13$, $p < .001$, rating type, $F(1,1475) = 1713.19$, $p < .001$, and a condition by rating type interaction, $F(2,1475) = 54.54$, $p < .001$. There was no main effect of age or any interactions with age, $ps \geq .285$, suggesting that children of all ages performed similarly.[2]

We examined the condition by rating type interaction by looking at the effect of condition for each rating type. We preregistered that we would run pairwise comparisons for 1vs3 and 3vs5, for both the initial ratings (when there is an effect of condition) and the final ratings. We also preregistered that we would correct p-values for multiple comparisons (significant p=0.05/2=0.025), and use Cohen's d to quantify the effect sizes of these comparisons.

For initial ratings, there was an effect of condition, $F(2,673) = 4.13$, $p = .017$, suggesting an overall pattern that children judged that the fewer resources someone has, the happier they will be about buying a desired item. Pairwise comparisons with corrected p-values revealed that initial ratings were different in only one comparison (with a small effect size): 1vs3, $p = .018$, $d = 0.21$, but were not different in the other: 3vs5, $p = .904$, $d = 0.01$. See Figure 2C. This suggests that like adults, although there is an overall linear relation between resource quantity and emotion, the effect is not big.

For final ratings, there was also an effect of condition, $F(2,673) = 73.75$, $p < .001$, suggesting an overall pattern that children judged that the fewer resources someone has, the sadder they will be about losing their item. Pairwise comparisons with corrected p-values revealed that final ratings were different in both comparisons: 1vs3, $p < .001$, $d = 0.53$; 3vs5, $p < .001$, $d = 0.49$, suggesting a pronounced and consistent effect of resource quantity on final emotion ratings. While the effect sizes in the two comparisons are similar, they are consistent with the pattern that the effect size of the comparison involving an initial possession of 1 resource (1vs3) is numerically larger than that of the other comparison (3vs5).

Difference between initial and final emotion ratings As in Experiment 1, we also ran analyses to examine the difference between children's initial and final emotion ratings. The final model was: `Difference ~ Condition * Age, random = ~ 1 | SubID, method = "REML"`. There was no main effect of age or any interaction with age, $ps \geq .441$, suggesting that children of all ages performed similarly. There was an effect of condition, $F(2,671) = 47.98$, $p < .001$, suggesting that children judged that the fewer resources someone has, the larger their decline in emotion after a negative event occurs. As above, we preregistered that if there is an effect of condition, we would run pairwise comparisons for 1vs3 and 3vs5. We found significant differences in both comparisons: 1vs3, $p < .001$, $d = 0.50$; 3vs5, $p < .001$, $d = 0.37$. Like with the final ratings, the effect size is numerically larger in 1vs3 than 3vs5. See Figure 2D. This is consistent with the idea that 8-10-year-olds may start to distinguish between whether someone has no resources left or still has resources left to deal with their outcome.

Together, the findings from this second experiment suggest that like adults, 8-10-year-olds consider others' resources when inferring their emotions. They judged that fewer resources would lead to sadder emotional responses to a lost item, and bigger changes in emotion (relative to when the

[2]For both the raw emotion ratings and the difference between initial and final emotion ratings, we had preregistered that we would include age in our follow-up analyses, however, given that there were no main effects or interactions with age, we deviated from this preregistered analysis by removing age from all of our follow-up analyses. Nonetheless, including age in these analyses as preregistered does not change the pattern of results.

person bought the item). While we only looked at resource conditions 1, 3, and 5 to accommodate children's attention spans, we again found that the comparison involving initially having 1 resource (1vs3) yielded a numerically larger effect size than the other comparison (3vs5; although it should be noted that the difference is small). This suggests an emerging ability to distinguish between someone who has no resources left to deal with their outcome and someone who still has resources.

General Discussion

In two preregistered experiments, we examined adults' and 8-10-year-olds' ability to consider others' resource quantities when inferring their emotions about the same outcome. Participants saw scenarios about people who desired a food item but differed in the number of items they had enough money to buy (ranging from 1 to 5). Both adults and children rated how the person felt when they bought the item and when they lost it. The fewer the resources someone had, the sadder adults and children thought they would be when losing their item, and the larger the emotional change they would experience (i.e., compared to when they bought the item). Further, adults judged that the influence of resource quantity on emotion inferences was strongest when someone had no resources left to deal with their negative situation compared to when they still have resources available. Children showed a weaker, but consistent pattern, suggesting an emerging ability to do so. Together, the study shows that adults and children by age 8 consider people's resources when inferring their emotions.

These findings extend our understanding of adults' and children's emotion inferences. They show that people do not just consider external cues or others' mental states when inferring emotions (e.g., Molinari et al., 2009; Wellman & Woolley, 1990; Widen & Russell, 2010, 2011), they also consider people's power instantiated by their available resources. Further, our study goes beyond prior studies that focused on the relation between one's power and first-person emotional experiences (e.g., Frijda et al., 1989; Roseman et al., 1996; Sillars & Davis, 2018; Smith & Ellsworth, 1985). We show that beyond people's immediate, memorized past experience, both adults and children have an intuitive, causal theory of how power and emotions relate. This knowledge allows them to flexibly draw causal inferences when reasoning about a third-party's emotion. Moreover, these inferences demonstrate a level of nuance. Instead of asking participants to make a forced choice between two agents with 2 vs. 5 resources (Ahl et al., 2023), we quantitatively manipulated the number of someone's resources from 1 to 5, and asked participants to rate the person's emotion on a 7-point emotion scale. Both adults and children demonstrated abilities to infer emotion in a graded manner based on resource quantities.

We interpret our findings as indicating that people can appraise others' ability to influence a negative event (as instantiated by their available resources) when inferring their emotional responses to the event. Another account that might also explain our findings is diminishing marginal utility (DMU), an economic principle stating that as the amount of resources increases, the value placed on each unit of the resource decreases (e.g., Ahl et al., 2023; Rachlin, 1992). This is consistent with our finding that when the same negative event occurs (i.e., the loss of an identical item), participants inferred sadder emotions in people with fewer resources. However, DMU cannot fully explain our findings. That is, if only DMU is at play, we might predict that people's emotion ratings would change in a relatively continuous manner as the number of resources changes. We did not find this. Instead, particularly in the results from adults, we found that participants showed the largest difference in ratings when people initially only had one resource versus two—more so than any other unit change of resource quantity. This suggests that they were especially sensitive to the distinction between when someone has no resources left to deal with their outcome and when they have just enough to modify their outcome. Nonetheless, while we favor our account, we do not view the two accounts as mutually exclusive. For example, it is likely that the evaluation of one's ability to alter a negative outcome (e.g., losing an item) underlies why they value the item differently. So these two accounts may be causally related, working in tandem to offer a comprehensive explanation for how people incorporate resources in their emotion inferences. Future research could provide further support for this possibility.

Here we looked at people's power through their financial resources. But people can deal with their situation in many different ways. People's power can also include their strength, knowledge, social attractiveness, ability to recruit for help, and so on. For instance, everyone would be upset if their car broke down, but someone with the knowledge of how to fix the car may be less upset than someone with limited knowledge of how to fix it. Future research can examine how these different abilities affect people's emotions and can also contrast different abilities with each other to see how it might differentiate people's emotions (e.g., would someone with the knowledge to fix their car feel similarly as someone who has the money to fix their car).

Future research can also examine how the relation between people's power and their emotions extends to more life-changing situations. Losing a snack is quite inconsequential in the grand scheme of things, yet adults and children are sensitive to people's available resources when predicting how they would feel. Would the same pattern of results hold for more extreme losses (e.g., a hurricane damaging one's house) or are some negative events so detrimental that even having more power would not mitigate its emotional impact?

In sum, children and adults incorporate others' power when inferring their emotions. They consider the amount of resources someone has and infers that someone would be sadder about a negative situation the less resources they have to deal with it. This work extends prior work on people's emotion inferences and shows that children and adults use a variety of different information when inferring others' emotions.

Acknowledgments

We would like to thank Georgina Mariyadas for their help with stimuli creation and Valery Sit for their help with data collection. This work is supported by a Discovery Grant from the Natural Sciences and Engineering Research Council of Canada (NSERC) and an Insight Development Grant from the Social Sciences and Humanities Research Council (SSHRC) awarded to Yang Wu.

References

Ahl, R. E., Cook, E., & Auliffe, K. (2023). Having less means wanting more: Children hold an intuitive economic theory of diminishing marginal utility. *Cognition*, *234*, 105367.

Barden, R. C., Zelko, F. A., Duncan, S. W., & Masters, J. C. (1980). Children's consensual knowledge about the experiential determinants of emotion. *Journal of Personality and Social Psychology*, *39*, 968–976.

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, *68*, 255–278.

Doan, T., Ong, D. C., & Wu, Y. (2023). Emotion understanding as third-person appraisals: Integrating appraisal theories with developmental theories of emotion. *PsyArXiv*.

Ellsworth, P. C., & Scherer, K. R. (2003). Appraisal processes in emotion. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective sciences.* Oxford University Press.

Frijda, N. H., Kuipers, P., & ter Schure, E. (1989). Relations among emotion, appraisal, and emotional action readiness. *Journal of Personality and Social Psychology*, *57*, 212–228.

Hadwin, J., & Perner, J. (1991). Pleased and surprised: Children's cognitive theory of emotion. *British Journal of Developmental Psychology*, *9*, 215–234.

Hardecker, D. J. K. (2020). The distinctive constitution of feeling hurt: A review and a lazarian theory. *European Psychologist*, *25*, 293–305.

Lazarus, R. S. (1991). Progress on a cognitive-motivational-relational theory of emotion. *American Psychologist*, *46*, 819–834.

Lemay, E. P., Overall, N. C., & Clark, M. S. (2012). Experiences and interpersonal consequences of hurt feelings and anger. *Journal of Personality and Social Psychology*, *103*, 982–1006.

Molinari, C., Burin, D., Saux, G., Barreyro, J. P., Irrazabal, N., Bechis, M. S., ... Ramenzoni, V. (2009). Fictional characters' emotional state representation: What is its degree of specificity? *Psicothema*, *21*, 9–14.

Mouw, J. M., Leijenhorst, L. V., Saab, N., Danel, M. S., & van den Broek, P. (2019). Contributions of emotion understanding to narrative comprehension in children and adults. *European Journal of Developmental Psychology*, *16*, 66–81.

Rachlin, H. (1992). Diminishing marginal value as delay discounting. *Journal of the Experimental Analysis of Behavior*, *57*, 407–415.

Roseman, I. J., Antoniou, A. A., & Jose, P. E. (1996). Appraisal determinants of emotions: Constructing a more accurate and comprehensive theory. *Cognition Emotion*, *10*, 241–278.

Scherer, K. R. (1993). Studying the emotion-antecedent appraisal process: An expert system approach. *Cognition Emotion*, *7*, 325–355.

Scott, K., Chu, J., & Schulz, L. (2017). Lookit (part 2): Assessing the viability of online developmental research, results from three case studies. *Open Mind*, *1*, 15–29.

Scott, K., & Schulz, L. (2017). Lookit (part 1): A new online platform for developmental research. *Open Mind*, *1*, 4–14.

Sillars, A. A., & Davis, E. L. (2018). Children's challenge and threat appraisals vary by discrete emotion, age, and gender. *International Journal of Behavioral Development*, *42*, 506–511.

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, *48*, 813–838.

Wellman, H. M., & Banerjee, M. (1991). Mind and emotion: Children's understanding of the emotional consequences of beliefs and desires. *British Journal of Developmental Psychology*, *9*, 191–214.

Wellman, H. M., & Woolley, J. D. (1990). From simple desires to ordinary beliefs: The early development of everyday psychology. *Cognition*, *35*, 245–275.

Widen, S. C., & Russell, J. A. (2010). Children's scripts for social emotions: Causes and consequences are more central than are facial expressions. *British Journal of Developmental Psychology*, *28*, 565–581.

Widen, S. C., & Russell, J. A. (2011). In building a script for an emotion, do preschoolers add its cause before its behavior consequence? *Social Development*, *20*, 471–485.